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Injury and Disability Identification and Reduction

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Air Force Research Laboratory
711th Human Performance Wing
Human Effectiveness Directorate
Biosciences and Protection Division
Biomechanics Branch
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Background. This effort was developed to support new initiatives within the Vulnerability Analysis Branch to enhance warfighter performance among all Airmen.
Methods. Electronic data were utilized in epidemiological investigations to identify Airmen at increased risk for decreased warfighter performance.
Results. Airmen consistently noted at increased risk included battlefield airmen and enlisted civil engineers.
Conclusions. This project fulfilled stated objectives. The follow-on work unit will utilize workplace investigational techniques to identify specific workplace hazards and take a broader approach, engaging individuals with expertise in biomechanics and ergonomics to identify specific hazards and develop recommendations to improve warfighter performance.

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TABLE OF CONTENTS

LIST OF TABLES

SUMMARY

Problem. To date, work-related, non-combat causes of injury and injury-related musculoskeletal disorders among Airmen have not been thoroughly evaluated. Granted, the Air Force Safety Center, using mishap reports, has identified leading causes of lost work days among Airmen and U.S. Air Force (USAF) civilian workers. For the period 1993 – 2002, lost workday injury rates for Airmen ranged from 2-4 per 1,000 while civilian rates ranged from 4-8 per 1,000. Subsequent analyses conducted by the Safety Center have shown the top three leading causes of injury for airmen to be: 1) operating a motor vehicle, 2) slips, trips, and falls, and 3) riding in/on a motor vehicle.(6) This report also identified the leading causes of lost workday injuries for USAF civilians to be: 1) slips, trips, and falls, 2) lifting and carrying objects, 3) slips, trips, and falls while climbing or descending stairs or ladders. This report utilized available electronic demographic, military-related, and medical data to identify Air Force Specialty Codes at increased risk for injuries, injury-related musculoskeletal disorders, hospitalizations, and associated inpatient and outpatient medical costs.

Results. In this project, a number of officer and enlisted Air Force specialties that were at increased hazard to be either hospitalized or receive outpatient medical care for either an injury or injury-related musculoskeletal disorder were identified. Among those with the most consistent findings included, enlisted Airmen serving as battlefield airmen or civil engineers. There are a number of existing efforts that are ongoing to improve the performance of the battlefield airmen. However, civil engineers appear ready to benefit from further analyses to identify workplace hazards and develop possible mitigating solutions to enhance warfighter performance.

Conclusions. This project fulfilled stated objectives in identifying Airmen at risk for decreased warfighter performance. This effort was comprised of epidemiological studies. The follow-on work unit is intended to utilize workplace investigational techniques to identify specific workplace hazards and take a broader approach, engaging individuals with expertise in biomechanics and ergonomics.

Recommendations. The next step should utilize surveys to better describe job-specific risks. Such a survey is the Job Requirements Physical Demands Survey (JRPDS), which has been approved by the Department of Defense Ergonomics Working Group. The Vulnerability Analysis Branch (711th HPW/RHPA) has expertise in the design and implementation of web-based surveys. In the follow-on work unit, a web-based JRPDS with email invitation will be utilized to further study warfighter performance among enlisted civil engineers.

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1.0 INTRODUCTION

According to the U.S. Bureau of Labor Statistics (BLS), private industry within the U.S. accrued over 1.1 million non-fatal occupational injuries and illnesses during 2006 (Bureau of Labor Statistics, 2006). The BLS reported the top five injuries/illnesses to be sprains & strains, fractures, cuts & punctures, and bruises. Additionally, the top three affected body locations were trunk, upper extremities, and lower extremities. Unfortunately, similar data is not available for members of the U.S. Armed Forces, and the U.S. Air Force (USAF) in particular. What is known comes from the Armed Forces Health Surveillance Center (Rubertone and Brundage, 2002), which publishes annual hospitalization and outpatient statistics for all Department of Defense (DoD) military personnel through Medical Surveillance Monthly Reports. This report publishes a global view of injuries and musculoskeletal disorder morbidity among U.S. service members. During 2008, injuries and poisonings (International Classification of Diseases, 9th Revision, Clinical Modifications (ICD-9-CM) 800-999) and diseases of the musculoskeletal system (ICD-9-CM 710-739) were the third and fourth, respectively, leading diagnoses for hospitalizations (Medical Surveillance Monthly Report, 2009a). The top five injury and poisoning hospitalization diagnoses for men were other complications of procedures, not elsewhere classifiable (nec) (9.5%), fracture of the ankle (5.4%), fracture of the face bones (4.6%), fracture of tibia and fibula (4.1%), and concussion (3.3%). The top five injury and poisoning hospital diagnoses for women were other complications of procedures, not (nec) (15.4%), poisoning by analgesics, antipyretics & antirheumatics (9.4%), fracture of the ankle (6.5%), complications affecting specified body systems nec (5.6%), and complications peculiar to certain specified procedures (5.5%). The top five musculoskeletal disease hospital diagnoses for men included intervertebral disc disorders (32.3%), internal derangement of knee (9.3%), other derangement of joint (7.7%), disorders of muscle, ligament and fascia (6.7%), and other disorders of bone and cartilage (6.4%). The top five musculoskeletal disease hospitalization diagnoses for women were similar to men and included intervertebral disc disorders (29.4%), internal derangement of knee (8.0%), other derangement of joint (7.8%), other disorders of bone and cartilage (7.2%), and other and unspecified disorders of back (7.0%). Outpatient visit data was also reported (Medical Surveillance Monthly Report, 2009b), with musculoskeletal diseases and injuries & poisonings ranked the second and fourth, respectively, leading categories of outpatient diagnoses. The top five outpatient musculoskeletal disease categories for men included other and unspecified disorders of joint (27.9%), other and unspecified disorders of back (20.7%), peripheral enthesopathies and allied syndromes (7.9%), and intervertebral disc disorders (6.5%). Results were similar for women in that unspecified disorders of joint (26.9%), other and unspecified disorders of back (19.9%), were ranked first and second, but differed in the remaining three categories: nonallopathic lesions, nec (8.0%), other disorders of soft tissues (7.7%), peripheral enthesopathies and allied syndromes (5.7%). The top three outpatient injury & poisoning categories were the same for men and women, with sprains and strains of ankle (10.7% and 12.8%), sprains and strains of knee and leg (10.3% and 12.8%), and sprains and strains, other/unspecified back (7.4% and 10.5%), respectively, listed as the top three conditions. Sprains and strains of shoulder and upper arm (5.8%), and injury, other and unspecified (4.5%) rounded out the top five outpatient categories for men while contusion of lower limb and of other/unspec site (4.0%), and certain adverse effects, nec (3.9%) rounded out the top five outpatient categories for women.

The only current data on injuries among USAF Airmen comes from the Air Force Safety Center, which compiles mishap reports. Using this data, the leading causes of lost work days among

Airmen and USAF civilian workers have been reported (Copley et al., 2003a). For the period 1993 – 2002, lost workday injury rates for Airmen ranged from 2-4 per 1,000 while civilian rates ranged from 4-8 per 1,000. Subsequent analyses conducted by the Safety Center (Copley et al., 2003b) have shown the top three leading causes of injury for airmen to be: 1) operating a motor vehicle, 2) slips, trips, and falls, and 3) riding in/on a motor vehicle.(6) This report also identified the leading causes of lost workday injuries for USAF civilians to be: 1) slips, trips, and falls, 2) lifting and carrying objects, 3) slips, trips, and falls while climbing or descending stairs or ladders.

The Vulnerability Analysis Branch (711th HPW/RHPA) has a legacy of research dedicated to aircrew safety (Smith and Smith, 2006; Smith, 2006; Yliniemi et al., 2009; Buhrman and Knox, 1997; Perry and Buhrman, 1995; Buhrman and Perry, 1994). However, there are currently over 490,000 Airmen whom receive Veteran's Adminstration (VA) disability compensation totaling more than $348 million annually (711th HPW/RHPA unpublished data). Additionally, Airmen lose over 17,000 duty days due to mishaps, and the rate for lost duty day injuries for Airmen is 4.9 per 100 (Copley et al., 2003b), which exceeds the National rate of 4.4 lost workday injuries and illnesses per100 (Bureau of Labor Statistics, 2006). In order to support current DoD and USAF priorities, it is important to reduce injury and disability among all USAF Airmen. In order to accomplish this, 711th HPW/RHPA acquired additional expertise in epidemiology and biostatistics which led to the establishment of the necessary infrastructure to identify Airmen at increased risk for decreased warfighter performance as a result of injury, illness, and disability. The goal of this research project is to identify Airmen at increased risk for injuries and injury-related musculoskeletal disorders that adversely impact warfighter performance.

2.0 METHOD, ASSUMPTION AND PROCEDURES

2.1 Data Assembly

Data procurement required the establishment of a Federal Privacy Act System of Records (Appendix 1) and data use agreements with the Defense Manpower Data Center (DMDC) and the Military Health System (MHS). Data available from the Defense Manpower Data Center were used to identify groups of officer and enlisted Airmen who served on active duty for a minimum of six months during the period October 1, 2001–December 31, 2005. DMDC maintains up-to-date and historical rosters of all active duty, reserve, guard, and DoD civilian personnel. These rosters include personal information such as gender, race/ethnicity, service, component, rank, date of birth, marital status, Air Force Specialty Codes (AFSCs) and others. Officer and enlisted Airmen were categorized into occupational categories based upon primary AFSCs using Air Force Manuals 36-2105 and 36-2108, both dated 31 October 2004, for officers and enlisted, respectively (Table 1).

Table 1. Air Force Specialty Code Categorization Scheme

Rank	Career area	Inclusive Primary AFSCs
Officer	Operations	10xx – 16xx
Officer	Logistics/Support	20xx – 21xx, 30xx – 38xx and 71xx (OSI)
Officer	Medical	40xx – 48xx
Officer	Professional/Acquisitions/Finance	51xx – 52xx, 60xx – 65xx
Officer	Other/Unknown	all others (includes special duty and reporting identifiers)
Enlisted	Aircrew	1A0xx – 1A8xx
Enlisted	CC/Intel/Protection/Weather/Plans	1C0xx, 1C1xx, 1C3xx, 1C5xx – 1C7xx 1N0xx – 1N6xx, 1T0xx,1T1xx, 1W0xx, 2G0xx
Enlisted	Battlefield Airmen	1C2xx, 1C4xx, 1T2xx
Enlisted	Maintenance/Fuels	2A0xx, 2A3xx, 2A5xx - 2A7xx, 2F0xx, 2M0xx, 2P0xx, 2R0xx, 2R1xx
Enlisted	Electronic Systems	2E0xx - 2E2xx, 2E6xx
Enlisted	Supply/Trans/Munitions	2S0xx, 2T0xx-2T3xx, 2W0xx – 2W2xx
Enlisted	Info Mngt/Comm	3A0xx, 3C0xx – 3C3xx,
Enlisted	CE	3E0xx – 3E9xx
Enlisted	Security Forces	3P0xx
Enlisted	Medical	4A0xx – 4A2xx, 4B0xx, 4C0xx, 4D0xx, 4E0xx, 4H0xx, 4J0xx, 4M0xx, 4N0xx, 4N1xx, 4P0xx, 4R0xx, 4T0xx, 4V0xx, 4Y0xx
Enlisted	Other/Unknown	3H0xx, 3M0xx, 3N0xx – 3N2xx, 3S0xx – 3S3xx, 3V0xx, 5J0xx, 5R0xx, 6C0xx, 6F0xx, 7S0xx, all others (includes special duty and reporting identifiers)

The MHS has three main data files, including: 1) the Standard Inpatient Data Record (SIDR), which contains one record for each encounter for care at a DoD hospital world-wide with up to eight International Classification of Diseases, 9th Revision, Clinical Modifications (ICD-9-CM) discharge diagnoses, and containing historical data from October 1988 to present; 2) Standard Ambulatory Data Record (SADR), which contains one record for each outpatient encounter for care at a DoD hospital or clinic, with up to three ICD-9-CM discharge diagnoses, and contains historical data from October 1996 to the present; and Purchased Care, which includes inpatient and outpatient care provided to US service members outside of a military treatment facility, and paid for by DoD insurance.

DMDC also provided a VA disability file. This file was limited in scope as it only provided the entitlement codes and the total annual disability payments. To study the association between AFSC and disability, entitlement codes indicating disability compensation were utilized, including: 01 = Persian Gulf War, 71 = Vietnam era, 41 = Regular, peacetime, 31 = Korean conflict, and 21 = WWII were selected.

DMDC rosters were used to identify Airmen who met the above inclusion criteria. Outcomes of interest included inpatient and outpatient discharge ICD-9-CM coded injuries and injury-related musculoskeletal disorders. Injuries included ICD-9-CM codes between 800.00 – 959.99, obtained from either the inpatient or outpatient medical data. Injury-related musculoskeletal

disorders were categorized using a matrix obtained from the US Army Center for Health Promotion and Preventive Medicine (USACHPPM). The USACHPPM matrix cross-categorizes injury location by injury type (Table 2).

Table 2. USACHPPM Injury-Related Musculoskeletal Disorder Matrix

Injury Location			Inflammation and Pain (Overuse)	Joint Derangement	Joint Derangement with Neurological Involvement	Stress Fracture	Sprains/Strains/ Rupture	Dislocation
	Vertebral Column	Cervical	723.1	722.0	722.71, 723.4			
		Thoracic/Dorsal		722.11	722.72, 724.4			
		Lumbar	724.2	722.10	722.73, 724.3			
		Sacrum, Coccyx	720.2					
		Spine, Back Unspecified	721.7, 724.5	722.2	722.70, 724.9	733.13		
Extremities	Upper	Shoulder	716.11, 719(.01,.11,.41), 726(.0,.1,.2)	718(.01,.11,.81,.91)			727(.61-.62)	718.31
		Upper arm, Elbow	716.12, 719(.02,.12,.42), 726.3	718(.02,.12,.82,.92)		733.11		718.32
		Forearm, Wrist	716.13, 719(.03,.13,.43), 726.4	718(.03,.13,.83,.93)		733.12		718.33
		Hand	716.14, 719(.04,.14,.44)	718(.04,.14,.84,.94)			727(.63-.64)	718.34
	Lower	Pelvis, Hip, Thigh	716.15, 719 (.05,.15,.45), 726.5	718(.05,.15,.85,.95)		733(.14-.15)	727.65	718.35
		Knee, Lower leg	716.16, 717.7, 719(.06,.16,.46), 726.6	717(.0-.6,.9), 718(.06,.16,.86,.96)		733(.16,.93)	717.8, 727(.66-.67)	718.36
		Ankle, Foot	716.17, 719(.07,.17,.47), 726.7, 728.71, 734	718(.07,.17,.87,.97)		733.94	727.68	718.37
Unclassified by Site	Others and Unspecified	Other specified/Multiple	716(.18-.19), 719(.08-.09,.18-.19,.48-.49), 726.8, 727.2	718(.08,.09,.18,.19,.88 ,.89,.98,.99)		733.19	727.69	718(.38,.39)
		Unspecified Site	716.10, 719(.00,.10,.40), 726.9, 727.3, 729.1	718(.00,.10,.80,.90)	729.2	733(.10,.95)	727.60, 728.83	718.30

2.1.1 Civil Engineering Analyses

To better understand the epidemiology of injuries and injury-related musculoskeletal disorders among enlisted civil engineers, further analyses were conducted to describe the leading causes for both injuries and injury-related musculoskeletal disorders. Injury-related musculoskeletal disorders were those classified using the USACHPPM matrix, as described above. Injuries were categorized using the Barell Matrix (Barell V et al., 2002; Fingerhut et al., 2002), which organizes ICD-9-CM coded injuries by body region and injury type (Table 3). These analyses were restricted to the larger civil engineering organizations as this would support future workplace evaluations that were anticipated to begin with the larger organizations. Therefore, these analyses were restricted to include only:

- **Structural:** Manages, constructs, repairs, and modifies structural systems and wooden, masonry, metal, and concrete buildings. Fabricates and repairs components of buildings, utility systems, and real property equipment.
- **Pavement & Construction Equipment:** Constructs and maintains concrete and asphalt runways, aircraft parking aprons, and roads. Operates and maintains heavy construction equipment, such as loaders, graders, dozers, backhoes, and dump trucks. Operates tractor-trailer combinations, transporting construction equipment, and materials.

Table 3. Barell Matrix Used To Code Injuries for Analyses to Determine Leading Categories of Injuries among Select Civil Engineering Career Fields

			Fracture	Dislocation	Sprains & Strains	Internal
Head and Neck	**Traumatic Brain Injury**	Type 1 TBI	800, 801, 803, 804(.1-.4, .6-.9) 800, 801, 803, 804(.03-.05,.53-.55)	/	/	850(.2-.4) 851-854*, 995.55
		Type 2 TBI	800, 801, 803, 804(.00,.02,.06,.09) 800, 801, 803, 804(.50,.52,.56,.59)	/	/	850(.0,.1,.5,.9)
		Type 3 TBI	800, 801, 803, 804(.01,.51)	/	/	/
	Other head, face and neck	Other Head	/	/	/	/
		Face	802	830	848.0-.1	/
		Eye	/	/	/	/
		Neck	807.5-.6	/	848.2	/
		Head, face and Neck Unspecified	/	/	/	/
Spine and Back	**Spinal Cord (SCI)**	Cervical SCI	806.0-.1	/	/	952.0
		Thoracic/Dorsal SCI	806.2-.3	/	/	952.1
		Lumbar SCI	806.3-.5	/	/	952.2
		Sacrum Coccyx SCI	806.6-.7	/	/	952.3-.4
		Spine & Back Unspecified	806.8-.9	/	/	952.8-.9
	Vertebral Column (VCl)	Cervical VCl	805.0-.1	839.0-.1	847.0	/
		Thoracic/Dorsal VCl	805.2-.3	839.21,.31	847.1	/
		Lumbar VCl	805.4-.5	839.20,.30	847.2	/
		Sacrum Coccyx VCl	805.6-.7	839(.41-.42, .51-.52)	847.3-.4	/
		Spine & Back Unspecified	805.8-.9	839(.40,.49,.50,.52)	/	/
Torso	**Torso**	Chest (Thorax)	807.0-.4	839.61,.71	848.3-.4	860-862
		Abdomen	/	/		863-866, 868
		Pelvis & Urogenital	808	839.69,.79	846, 848.5	867
		Trunk	809	/	/	/
		Back & Buttock	/	/	847.9	/
Extremities	**Upper**	Shoulder & Upper Arm	810-812	831	840	/
		Forearm & Elbow	813	832	841	/
		Wrist, hand & Fingers	814-817	833, 834	842	/
		Other & Unspecified	818	/	/	/
	Lower	Hip	820	835	843	/
		Upper leg & Thigh	821	/	/	/
		Knee	822	836	844.0-.3	/
		Lower leg & Ankle	823-824	837	845.0	/
		Foot & Toes	825-826	838	845.1	/
		Other & Unspecified	827		844.8,.9	/

Table 3 continued						
			Fracture	**Dislocation**	**Sprains & Strains**	**Internal**
Unclassified by Site	**Other & Unspecified**	Other/Multiple	819, 828	/	/	/
		Unspecified Site	829	839.8-.9	848.8-.9	869
	System-Wide	System-wide & Late Effect	905-908, 909(.0,.1,.2,.4,.9), 930-939, 958, 960-994, 995.50-.54, .59, 995(.80-.85)			

Table 3 continued

			Open Wound	Amputations	Blood Vessels	Contusion/ Superficial
Head and Neck	**Traumatic Brain Injury**	Type 1 TBI	/	/	/	/
		Type 2 TBI	/	/	/	/
		Type 3 TBI	/	/	/	/
	Other head, face and neck	Other Head	873.0-.1,.8-.9	/	/	/
		Face	872, 873.2-.7	/	/	/
		Eye	870-871	/	/	918, 921
		Neck	874	/	/	/
		Head, face and Neck Unspecified	/	/	900	910, 920
Spine and Back	**Spinal Cord (SCI)**	Cervical SCI	/	/	/	/
		Thoracic/Dorsal SCI	/	/	/	/
		Lumbar SCI	/	/	/	/
		Sacrum Coccyx SCI	/	/	/	/
		Spine & Back Unspecified	/	/	/	/
	Vertebral Column (VCl)	Cervical VCl	/	/	/	/
		Thoracic/Dorsal VCl	/	/	/	/
		Lumbar VCl	/	/	/	/
		Sacrum Coccyx VCl	/	/	/	/
		Spine & Back Unspecified	/	/	/	/
Torso	**Torso**	Chest (Thorax)	875, 879.0-.1	/	901	922(.0,.1,.33)
		Abdomen	879.2-.5	/	902.0-.4	922.2
		Pelvis & Urogenital	877-878	/	902(.5, .81-.82)	922.4
		Trunk	879.6-.7	/	/	911, 922.8-.9
		Back & Buttock	876	/	/	922.31-.32
Extremities	**Upper**	Shoulder & Upper Arm	880	887.2-.3	/	912, 923.0
		Forearm & Elbow	881.x0-.x1	887.0-.1	/	923.1
		Wrist, hand & Fingers	881.x2, 882 883	885-886	/	914-915, 923.2-.3
		Other & Unspecified	884	887.4-.7	903	913, 923.8-.9
	Lower	Hip	/	/	/	924.01
		Upper leg & Thigh	/	897.2-.3	/	924.00
		Knee	/	/	/	924.11
		Lower leg & Ankle	/	897.0-.1	/	924.10,.21
		Foot & Toes	892-893	895-896	/	917, 924.3,.20
		Other & Unspecified	890-891, 894	897.4-.7	904.0-.8	916, 924.4-.5
Unclassified by Site	**Other & Unspecified**	Other/Multiple	/	/	902.87,.89	/
		Unspecified Site	879(.9-.9)	/	902.9, 904.9	919, 924.8,.9

Table 3 continued

			Crush	Burns	Nerves	Unspecified
Head and Neck	**Traumatic Brain Injury**	Type 1 TBI	/	/	950.1-.3	/
		Type 2 TBI	/	/	/	/
		Type 3 TBI	/	/	/	/
	Other head, face and neck	Other Head	/	941.x6	951	959.01*
		Face	/	941.x1,.x3-.x5,.x7	/	/
		Eye	/	940, 941.x2	950(.0,.9)	/
		Neck	925.2	941.x8	953.0, 954.0	/
		Head, face and Neck Unspecified	925.1	941.x0,.x9, 947.0	957.0	959.09
Spine and Back	**Spinal Cord (SCI)**	Cervical SCI	/	/	/	/
		Thoracic/Dorsal SCI	/	/	/	/
		Lumbar SCI	/	/	/	/
		Sacrum Coccyx SCI	/	/	/	/
		Spine & Back Unspecified	/	/	/	/
	Vertebral Column (VCl)	Cervical VCl	/	/	/	/
		Thoracic/Dorsal VCl	/	/	/	/
		Lumbar VCl	/	/	/	/
		Sacrum Coccyx VCl	/	/	/	/
		Spine & Back Unspecified	/	/	/	/
Torso	**Torso**	Chest (Thorax)	926.19	942.x1-.x2	953.1	/
		Abdomen	/	942.x3, 947.3	953.2, 953.5	/
		Pelvis & Urogenital	926(.0,.12)	942.x5, 947.4	953.3	/
		Trunk	926.8-.9	942.x0, 942.x9	954.1,.8-.9	959.1
		Back & Buttock	926.11	942.x4	/	/
Extremities	**Upper**	Shoulder & Upper Arm	927.0	943.x3-.x6	/	959.2
		Forearm & Elbow	927.1	943.x1-.x2	/	/
		Wrist, hand & Fingers	927.2-.3	944	/	959.4-.5
		Other & Unspecified	927.8-.9	943.x0,.x9	953.4, 955	959.3
	Lower	Hip	928.01	/	/	/
		Upper leg & Thigh	928.00	945.x6	/	/
		Knee	928.11	945.x5	/	/
		Lower leg & Ankle	928.10,.21	945.x3-.x4	/	/
		Foot & Toes	928.3,.20	945.x1-.x2	/	/
		Other & Unspecified	928.8,.9	945.x0-.x9	/	959.6-.7
Unclassified by Site	**Other & Unspecified**	Other/Multiple	/	947.1-.2	953.8, 956	/
		Unspecified Site	929	946, 947.8,.9, 948, 949	953.9, 957.1,.8,.9	959.8,.9

* Note from CDC: 959.01 (added to ICD-9-CM in 1997) is not intended to be assigned to TBI.

- **Electric Power Production:** Installs, removes, operates, maintains, and repairs electrical power generating and control systems, aircraft arresting systems, and associated equipment.
- **Fire Protection:** Protects people, property, and the environment from fires and disasters. Provides fire prevention, fire fighting, rescue, and hazardous material responses.
- **Utilities Systems:** Installs, inspects, repairs, and manages plumbing, water distribution, wastewater collection systems and components, fire suppression and backflow prevention systems.
- **Heating, Ventilation and Air Conditioning (HVAC) & Refrigeration:** Installs, operates, maintains, and repairs heating, ventilation, air conditioning and refrigeration systems, combustion equipment, and industrial air compressors. Maintains and repairs nonelectric kitchen equipment. Manages HVAC and Refrigeration functions and activities.
- **Electrical Systems:** Installs, inspects, maintains, troubleshoots, repairs, and modifies electrical distribution systems and components above and below 600 volts; airfield lighting systems; fire alarms and intrusion detection systems.

Finally, the Senior Ergonomic Consultant at the USAF School of Aerospace Medicine (USAFSAM), recommended studying the differences in the enlisted civil engineering hazard by major command (Majcom). Once again, hazard ratios were computed for each of the four study outcomes, using Air Education and Training Command (AETC) as the reference group.

2.1.2 Analyses of Cost Data

AFSCs were analyzed for differences in the direct medical costs associated with inpatient and outpatient medical visits for injuries and injury-related musculoskeletal disorders. This analysis provided additional information on the burden injuries and injury-related musculoskeletal disorders inflict on the USAF. Data obtained from the MHS included direct costs for medical care provided, which was used to calculate direct medical costs associated with each injury and injury-related musculoskeletal disorder. Calculated were total medical costs and cost per person per year for each AFSC for injuries and injury-related musculoskeletal disorders. Cost per person per year is a weighted measure accounting for the total number of individuals and the follow-up time that each individual contributed within an AFSC category, and was calculated by taking the total cost and dividing it by the number of person-years accumulated by individuals within each AFSC category.

2.2 Statistical Analyses

Univariate and multivariate analyses were performed using SAS® Version 9.2 (SAS Institute, Cary NC). Demographic and military-specific data were examined using Pearson's chi-square tests to determine univariate differences. A stratified Cox proportional hazards model (Cox, 1972), stratifying on gender, was used to calculate hazard ratios and associated 95% confidence intervals to examine the risks of inpatient and outpatient visits for injuries and injury-related musculoskeletal disorders. The decision to stratify on gender was made *a priori* under the assumption that injury and injury-related musculoskeletal disorders would differ by gender

(Berdahl, 2008; Islam et al., 2001; Bell et al., 2000; Kraus et al., 1997). Race was categorized as white non-Hispanic, black non-Hispanic, and other. Marital status was categorized as married and not married. Pay grade or rank was categorized as E1-E3, E4-E6, and E7 and greater. Birth year was categorized as 1965 and before, 1966-1975, and 1976 and later. Period of first service was categorized as 1990 and before, 1991-1995, 1996-2000, and 2001-2005 and defined as the period of time in which an Airman first served in the USAF. Duration of service was categorized as 3 or less years, 4-9 years, 10-15 years, and 16 or more years. Finally, deployment status was defined as yes or no based on deployment in support of the current conflicts, Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF). Pay grade or rank, period of first service, and duration of service were all excluded from final multivariate analyses due to high collinearity with birth year. For the study of enlisted civil engineers, the decision to not stratify on gender was made after noticing the sparse number of females across the sub-groups of interest. Person-time for each study subject began at either the beginning date of the study, October 1, 2001, or date entered active duty service, whichever occurred later, and ended at either the end of the study, December 31, 2005, the date the Airman had an outcome of interest, or the date the Airman left military service, whichever occurred earlier. Multivariable logistic regression was used to calculate odds ratios and 95% confidence intervals for disability analyses, as the DMDC VA disability file was not amendable to identifying date of disability making it impractical to assign person-time.

3.0 RESULTS AND DISCUSSIONS

3.1 Officer Analyses

Tables that accompany these analyses can be found in Appendix 2.

There were 62,742 and 15,072 male and female officers, respectively, who served on active duty during October 1, 2001 and December 31, 2005 and met study criteria. Compared wtih the women, men were proportionately more likely to have served in professional, operations, and in the other/unknown AFSC categories, were white, non-Hispanic, married, officers in the grade of 04 or higher, older, began serving before 1990, had longer durations of service, and had been deployed (Table A2.1).

Multivariable Cox proportional hazards modeling was used to model the hazard for injuries and injury-related hospitalizations and outpatient visits, and were stratified by gender (Tables A2.2-A2.3). Models were adjusted for race/ethnicity, marital status, birth year, and deployment status, and those serving in professional career fields served as the reference category. In these analyses, the following findings were statistically significant ($p < 0.05$):

- Men serving in medical AFSCs were at statistically significantly increased hazard for hospitalizations as a result of an injury-related musculoskeletal disorder.
- Men serving in operations and men and women serving in logistic/support were at statistically significantly increased hazard for outpatient injuries.
- Men and women serving in medical specialties were at statistically significantly decreased hazard for outpatient injuries.

- Men and women serving in logistic/support and men serving in other/unknown specialties were at statistically significantly increased hazard for outpatient injury-related musculoskeletal disorders.
- Men serving in medical specialties were at statistically significantly decreased hazard for outpatient injury-related musculoskeletal disorders.

3.2 Enlisted Analyses

Tables that accompany these analyses can be found in Appendix 3.

Enlisted Airmen analyses included 284,270 men and 72,827 women who served in enlisted specialties and were active duty between October 1, 2001 and December 31, 2005, and met inclusion criteria. Women are not currently authorized to serve in battlefield airmen career fields, so analyses for battlefield airmen contain only men. Compared with women, men were proportionately more likely to specialize as aircrew, maintenance/fuels, electronic systems, supply/transportation/munitions, civil engineering, or security forces, to be white, non-Hispanic, married, more senior in rank, older, began serving prior to 1975, had longer periods of service, and had been deployed (Table A3.1).

Multivariable Cox proportional hazards modeling was used to model the hazard for injuries and injury-related hospitalizations and outpatient visits, and were stratified by gender (Tables A3.2-A3.3). Models were adjusted for race/ethnicity, marital status, birth year, and deployment status, and those serving in information management/communications fields served as the reference group. In these analyses, the following findings were statistically significant ($p < 0.05$):

- Men with aircrew, battlefield airmen, or electronic systems AFSCs, and men and women who served in maintenance/fuels, supply/transportation/munitions, civil engineering, or security forces, and women serving in command/intelligence/protection/weather/plans career fields were at statistically significantly increased hazard for an injury hospitalizations.
- Men with battlefield airmen, maintenance/fuels, or supply/transportation/munitions AFSCs, and men and women who served in civil engineering, or security forces, were at statistically significantly increased hazard for hospitalizations due to injury-related musculoskeletal disorders.
- Men serving in aircrew, battlefield airmen, security forces, or medical AFSCs and men and women serving in maintenance/fuels, electronic systems, supply/transportation/munitions, or civil engineering were at statistically significantly increased hazard for outpatient injuries.
- Men and women serving in command/intelligence/protection/weather/plans career fields were at statistically significantly decreased hazard for outpatient injuries.
- Men serving in aircrew, battlefield airmen, and medical AFSCs and men and women serving in electronic systems, supply/transportation/munitions, and civil engineering specialties were at statistically significantly increased hazard for outpatient injury-related musculoskeletal disorders.

- Men and women serving in command/intelligence/protection/weather/plans and security forces specialties were at statistically significantly decreased hazard for outpatient injury-related musculoskeletal disorders.

3.2.1 Analyses of Enlisted Civil Engineers

The goal of this project was to identify an AFSC category that may benefit from further investigations to identify specific workplace hazards and potential solutions to reduce hazards for injuries and/or injury-related musculoskeletal disorders that adversely impact warfighter performance. When assessing the results for the enlisted career fields, two AFSC categories demonstrated a consistent increased risk for injuries and injury-related musculoskeletal disorders, including battlefield airmen and civil engineers. Efforts supporting battlefield airman are being addressed in other programs, leaving civil engineers as the best choice for further study. To better understand injury and injury-related musculoskeletal disorder trends within the enlisted civil engineering career field, analyses were conducted among the different categories of civil engineers (Table A3.4). Although some careers were at increased risk for the various outcomes measured, no one organization stood out as having consistently elevated hazards across all measures. Specifically, enlisted Airmen working in operations management, readiness, structural, and utilities systems were at statistically significantly increased hazard for outpatient injury-related musculoskeletal disorders. Conversely Airmen working in explosive ordnance disposal were at statistically significantly decreased hazard for outpatient injury-related musculoskeletal disorders. Airmen working in pest management were almost three times more likely to be hospitalized with an injury than the reference group. Finally, a number of categories were at statistically significantly increased hazard for outpatient injuries, including electric power production, electrical systems, fire protection, HVAC & refrigeration, pavements & construction equipment, readiness, structural, and utilities systems.

To better understand the epidemiology of injuries and injury-related musculoskeletal disorders among enlisted civil engineers, further analyses were conducted to describe the leading causes for both injuries and injury-related musculoskeletal disorders among the larger civil engineering specialties (Table A3.5). Overuse of the back was the most common injury-related musculoskeletal disorder, followed by overuse of the knee or lower leg, overuse of the ankle or foot, overuse of the shoulder, and overuse of the neck. Overuse of the back, overuse of the knee or lower leg, and overuse of the cervical spine were clearly ranked number one, two, and five among the injury-related musculoskeletal disorders based upon the percentile range. However, overuse of the ankle or foot and overuse of the shoulder was not consistently the third or fourth injury-related musculoskeletal disorders, with ranking depending upon specialty. Findings differed somewhat for injuries compared to injury-related musculoskeletal disorders. Under injuries, injuries to the hand, wrist, or fingers ranked highest, followed by injuries to the lower leg or ankle, lower leg unspecified, back, and shoulder or upper arm (Table A3.5). Injuries to the hand, wrist, or fingers, and injuries to the shoulder or upper arm were ranked highest and lowest, respectively, among all included specialties based upon percentile range. However, rank changed somewhat depending upon specialty for injuries of the lower leg or ankle, lower leg unspecified, and back.

Finally, the Senior Ergonomic Consultant at the 711th HPW/USAFSAM, recommended the assessment of the enlisted civil engineering hazards by major command (Majcom). Table A3.6 shows that enlisted civil engineers serving in Air Force Special Operations Command were at statistically significantly elevated hazard for outpatient injury-related musculoskeletal disorders. Conversely, enlisted civil engineers serving in Pacific Air Force (PACAF) and U.S. Air Forces, Europe (USAFE) were at statistically significantly reduced hazard for outpatient injury-related musculoskeletal disorders. Enlisted civil engineers serving in Air Force Space Command were at statistically significantly decreased hazard for injury hospitalization. Enlisted civil engineers serving in Air Combat, Air Force Space, and Air Mobility Commands and those serving in PACAF and USAFE were observed to have statistically significantly decreased hazards for outpatient injuries.

3.3 Disability Analyses

Tables that accompany these analyses can be found in Appendix 4.

3.3.1 Officers

The officer and enlisted data were linked to the DMDC VA disability file to study the association between AFSC category and VA disability compensation. There were 13,455 male officers and 3,834 female officers who had separated from the AF during the study period. Among those separated, 5,384 (40.0%) of men and 1,500 (39.1%) of women were identified as receiving VA disability compensation. Male officers who received disability compensation were proportionately more likely to serve in operations, support/logistics, and other/unknown specialties, were either black, non-Hispanic or other/unknown race/ethnicity, married, O4 pay grade or higher, born before 1965, began serving prior to 1990, had served 16 years or more, and had not been deployed. Female officers who received disability compensation were proportionately more likely to serve in medical and other/unknown specialties, were black, non-Hispanic, O4 pay grade or higher, born before 1965, began serving prior to 1990, had served 16 years or more, and had not been deployed (Table A4.1).

3.3.2 Enlisted Airmen

There were 81,306 enlisted men and 22,452 enlisted women who had separated from the AF during the study period. Among those separated, 28,636 (35.2%) of men and 7,943 (35.4%) of women were identified as receiving VA disability compensation. Compared with non-disabled enlisted men, disabled enlisted men were proportionately more likely to have served as aircrew, cc/intel/protection/weather/plans, info management/communications, battlefield airmen, electronic systems, supply/transportation/munitions, medical, and other/unknown specialties, were black non-Hispanic or other/unknown race/ethnicity, married, more senior in rank, born prior to 1966, began serving prior to 1990, had served more than 15 years, and had not been deployed. Compared with non-disabled enlisted women, disabled enlisted women were proportionately more likely to have served as info management/communications, medical, and other/unknown specialties, were black non-Hispanic race/ethnicity, married, more senior in rank, born prior to 1966, began serving prior to 1996, had served 10 or more years, and had not been deployed (Table A4.2).

3.3.3 Multivariable Analyses for Disability

As with previous officer and enlisted multivariable analyses, models were adjusted for race/ethnicity, marital status, birth year, and deployment status, and those officers serving in professional career fields and those enlisted Airmen serving in info management/communications served as the respective reference categories. In these analyses, male officers serving as logistics/support professionals were at statistically significantly increased hazard for receipt of VA disability compensation. While enlisted men specializing in battlefield airmen, maintenance, supply/transportation/munitions, civil engineering, medical, and other/unknown specialties were at statistically significantly increased hazard for receipt of VA disability compensation. The only enlisted female group at statistically significantly increased hazard for receipt of VA disability compensation were those serving in medical specialties. Conversely, enlisted women serving in cc/intel/protection/weather/plans and electronic systems were at statistically significantly decreased hazard for receipt of VA disability compensation. (Table A4.3)

3.4 Analyses of Direct Medical Cost Data

Tables that accompany these analyses can be found in Appendix 5.

Total direct costs for both injuries and injury-related musculoskeletal disorders were $172,920,331. Injuries accounted for 54.6% of the total direct medical costs (data not shown). Officers in operations had the highest total costs for both injuries and injury-related musculoskeletal disorders, while medical officers had the highest cost per person-year for injury-related musculoskeletal disorders and professional officers had the highest cost per person-year for injuries (Table A5.1). Enlisted airmen working in maintenance/fuels had the highest total costs for both injuries and injury-related musculoskeletal disorders, while enlisted personnel working in civil engineering had the highest cost per person-year for injury-related musculoskeletal disorders and battlefield airmen had the highest cost per person-year for injuries.

Direct medical costs were also calculated for the enlisted Civil Engineers separately. Civil engineers had a combined total of $13,190,779 in direct medical costs for injuries and injury-related musculoskeletal disorders, representing 10% of all enlisted direct medical costs for injury-related musculoskeletal disorders, and 7% of all enlisted direct medical costs for injuries (data not shown). Airmen serving in structural career fields had the highest direct medical costs for injury-related musculoskeletal disorders, while fire protection specialists had the highest direct medical costs for injuries. Conversely, Airmen serving in operations management had the highest cost per person-year for injury-related musculoskeletal disorders, and pest management Airmen had the highest cost per person-year for injuries (Table A5.2).

4.0 CONCLUSION

4.1 Summary of Findings

In this study, a number of officer and enlisted Air Force specialties that were at increased hazard for hospitalizations or receipt of outpatient medical care for either an injury or injury-related musculoskeletal disorder were identified. Among those with the most consistent findings included enlisted Airmen serving as battlefield airmen or civil engineers. There are a number of existing efforts that are ongoing to improve the performance of the battlefield airmen (Warha et al., 2009). Civil engineers appear ready to benefit from further analyses to identify workplace hazards and develop possible mitigating solutions to enhance warfighter performance.

4.2 Officer Analyses

Male medical officers had increased hazard for hospitalization for injury-related musculoskeletal disorders, yet were at decreased hazard for outpatient injury-related musculoskeletal disorders and outpatient injuries. Female medical officers were only found to be at decreased hazard for outpatient injuries. The association between healthcare workers and work-related musculoskeletal disorders is well established (Waters et al., 2006). The most plausible explanation regarding disparate findings between the hospitalization analyses and the outpatient analyses is that medical personnel are more likely to self-medicate, or work around the medical system for minor injuries than are other officers. However, they may also have somewhat better access to care that may lead to increased hazard for hospitalization. Male and Female officers specializing in logistics/support had a 16% - 21% increased hazard for outpatient injuries and injury-related musculoskeletal disorders. This group also had a 45% increased hazard for disability compensation. This category includes a wide range of specialties including aircraft, munitions, and missile maintenance, security forces, civil engineering, etc., and is worth further study, should resources allow.

4.3 Enlisted Analyses

Although a number of enlisted specialties exhibited increased hazard for one of the outcomes under study, including disability compensation, and are worthy of further efforts to identify root causes and explore solutions, male and female civil engineers demonstrated increased hazards across all study measures. The only exception was that female civil engineers were not at increased hazard for disability compensation. This finding is similar to results reported by the Air Force Safety Center that utilized passive mishap reporting and identified the top three functional areas of overall (military and civilian) lost workdays due to mishaps to be aircraft maintenance, civil engineering, and services (Copley et al., 2003b). To better understand the relations between enlisted civil engineers and these indicators of possible performance decrements, further analyses were conducted among the various civil engineering specialties. During multivariable analyses, those who worked as engineers were utilized as the reference group. A number of statistically significant positive findings were observed, yet no one group among all enlisted civil engineering specialties stood out as being at a consistently elevated hazard. Granted, enlisted Airmen working as readiness, structural, and utilities systems

specialists were at increased hazard for outpatient injuries and injury-related musculoskeletal disorders, caution must be exercised when making inferences based upon outpatient data alone, for reasons discussed below. However, it is worth noting that the relatively small group of pest managers (n=343, 1.3% of all enlisted civil engineers) were over 2.5 times as likely to be hospitalized with an injury and had the highest direct injury costs on a per person-year basis. Also noteworthy is that civil engineers who specialized in operations management, another relatively small group (n=832, 3.2% of all enlisted civil engineers), had a 22% increased hazard for an outpatient injury-related musculoskeletal disorder and had the highest direct medical costs for injury-related musculoskeletal disorders on a per person-year basis. The distribution of injury-related musculoskeletal disorders and injuries reported in this study (Table A3.5) is similar to those reported in other surveillance studies conducted among members of the U.S. armed forces (Medical Surveillance Monthly Report, 2009a), and data reported by the BLS for the U.S. civilian population (Bureau of Labor Statistics, 2006). The distribution of injuries also agrees well with mishap data reported to the Air Force Safety Center, in which the top three body parts injured among military civil engineering Airmen were fingers, legs, and eyes (Copley et al., 2003b). Analyses of enlisted civil engineers by major command was unfruitful as the only significant finding of note was that those assigned to USAF Special Operations command were at a 17% increased hazard for outpatient injury-related musculoskeletal disorders.

4.4 Limitations and Strengths

Study results must be interpreted within the limitations of the data available for use. This study utilized electronic demographic and medical data that was not purposely collected for epidemiological studies. It is possible that there is misclassification based upon AFSC. Specialty codes are dynamic with respect to time and to minimize any misclassification due to cross-training into a different AFSC, AFSC was assigned at study entry and follow-up time was terminated when Airmen were identified as cross-training into another AFSC. The hospitalization and outpatient data used to identify injury and injury-related musculoskeletal disorders is derived from ICD-9-CM codes, which are numeric codes assigned using a standardized international coding system. However, the coding scheme is quite complex and the level of training among individuals assigning these codes is quite diverse, including medical technicians, health care providers, and individuals with special training in medical coding. It is believed that coding is likely to be more accurate for hospital diagnoses than outpatient diagnoses for several reasons. First, there is less diversity among coders, with a greater proportion of diagnoses accomplished by individuals with training in medical coding. Secondly, MHS hospitalization data dates back to FY1988 allowing more time for quality improvement measures to be implemented in contrast to MHS outpatient data which was not collected until FY1998. In order to overcome possible coding errors, it was important to consider both the hospital and outpatient data when interpreting increased hazard for warfighter performance as replication of findings (hospitalizations, outpatient diagnoses, disabilities, direct medical costs) is considered to be important when assessing causal relations in epidemiological research (Gordis, 1996). Finally, it was not possible to identify the cause of the injury or injury-related musculoskeletal disorder using the MHS data. As a result, an assumption had to be made that the baseline injury and injury-related musculoskeletal disorder rate was constant across AFSCs, and that any excess was likely attributable to differences in workplace exposures. This

assumption is likely valid in that hazard ratios were adjusted for factors that may influence differences in baseline rates, such as age, marital status, and deployments.

This study had a number of strengths. Included were over 77,000 officers and 350,000 enlisted Airmen, allowing sufficient statistical power to study the outcomes of interest. A number of data sources and outcomes could be utilized to assess replication of findings. Using electronic hospitalization and outpatient data provided objective measures of health status, thus minimizing recall bias and other biases associated with subjective (self-reported) health status. Hospitalization diagnoses from MHS data have been successfully utilized and have passed peer-review for a number of other studies among military populations (Smith et al., 2004; Hooper et al., 2008; Hansen et al., 2007; Wells et al., 2006; Lindstrom et al., 2006) supporting the validity of this methodological approach. Additionally, medical care is free and with equal access for all Airmen, such that injuries and injury-related musculoskeletal disorders of sufficient severity to warrant medical care were likely captured. This reduced the likelihood of under-reporting believed to be present in other passive reporting surveillance systems which rely on supervisors to initiate injury reports.

5.0 RECOMMENDATIONS

This project fulfilled the stated objectives to identify Airmen at increased risk for decreased warfighter performance. This initial effort was comprised of epidemiological studies. Follow-on work is intended to utilize workplace investigations to identify specific workplace hazards and take a broader methodological approach, engaging individuals with expertise in biomechanics and ergonomics. Additionally, this process will utilize surveys to better describe job-specific risks. Such a survey is the Job Requirements Physical Demands Survey (JRPDS), which has been approved by the DoD Ergonomics Working Group (Appendix 6). The 711th HPW/RHPA has expertise in the design and implementation of web-based surveys. In the follow-on work unit, web-based JRPDS with email invitation will likely be utilized to further study warfighter performance among enlisted civil engineers.

REFERENCES

Armed Forces Health Surveillance Center, "Hospitalizations among members of active components, U.S. Armed Forces, 2008" Medical Surveillance Monthly Report, 16(04):10-5, 2009.

Armed Forces Health Surveillance Center, "Ambulatory visits among members of active components, U.S. Armed Forces, 2008," Medical Surveillance Monthly Report,16(04): 16-21, 2009.

Barell, V., Aharonson-Daniel, L., Fingerhut, L.A., Mackenzie, E.J., Ziv, A., Boyko, V., Abargel, A., Avitzour, M., Heruti, R., "An introduction to the Barell body region by nature of injury diagnosis matrix," Inj Prev, 8(2):91-6, 2002.

Bell, N.S., Mangione, T.W., Hemenway, D., Amoroso, P.J., Jones, B.H., "High injury rates among female army trainees: a function of gender?," Am J Prev Med,18(3 Suppl):141-6, 2000.

Berdahl, T.A., "Racial/ethnic and gender differences in individual workplace injury risk trajectories: 1988-1998," Am J Public Health, 98(12):2258-63, 2008.

Buhrman, J.R., Perry, C.E., "Human and manikin head/neck response to +Gz acceleration when encumbered by helmets of various weights," Aviat Space Environ Med, 65(12):1086-90, 1994.

Buhrman, J.R., Knox, F.S. 3rd.," Development of a biodynamics work environment (BWE) which integrates a biodynamics data bank, models, and analytical tools," Biomed Sci Instrum, 33:316-20, 1997.

Bureau of Labor Statistics, "Occupational Injuries and Illnesses: Counts, Rates, and Characteristics, 2006," U.S. Department of Labor, Available at: http://www.bls.gov/iif/oshbulletin2006.htm.

Copley, B., Burnham, B., Shim, M., "Descriptive Epidemiology of USAF Lost Workday Injuries, FY93-FY02. Part I. General Trends and Summaries," Research and Epidemiology Branch, Air force Safety Center, 2003.

Copley, B., Burnham, B., Shim, M., "Descriptive Epidemiology of USAF Lost Workday Injuries, FY93-FY02. Part II. Detailed Analysis for Mishap Prevention," Research and Epidemiology Branch, Air force Safety Center, 2003.

Cox, D., "Regression models and life tables (with discussion)," JR Stat Soc, B34:187, 1972.

Fingerhut, L.A., Aharonson-Daniel, L., Mackenzie, E.J., Ziv, A., Boyko, V., Abargel, A., Avitzour, M., Heruti, R., "The Barell matrix," Inj Prev, 8(3):259, 2002.

Gordis, L., "*Epidemiology,"* Philadelphia PA: W.B. Saunders Company, 1996: pp 176.

Hansen, C.J., Russell, K.L., Smith, T.C., Neville, J.S., Krauss, M.R., Ryan, M.A., "Asthma hospitalizations among US military personnel, 1994 to 2004," Ann Allergy Asthma Immunol, 98(1):36-43, 2007.

Hooper, T.I., Debakey, S.F., Nagaraj, B.E., Bellis, K.S., Smith, B., Smith, T.C., Gackstetter, G.D., "The long-term hospitalization experience following military service in the 1991 Gulf War among veterans remaining on active duty, 1994-2004," BMC Public Health, 13;8:60, 2008.

Islam, S.S., Velilla, A.M., Doyle, E.J., Ducatman, A.M., "Gender differences in work-related injury/illness: analysis of workers compensation claims," Am J Ind Med, 9(1):84-91, 2001.

Kraus, J.F., Schaffer, K.B., McArthur, D.L., Peek-Asa, C., "Epidemiology of acute low back injury in employees of a large home improvement retail company," Am J Epidemiol, 146(8):637-45, 1997.

Lindstrom, K.E., Smith, T.C., Wells, T.S., Wang, L.Z., Smith, B., Reed, R.J., Goldfinger, W.E., Ryan, M.A., "The mental health of U.S. military women in combat support occupations," J Womens Health (Larchmt), 15(2):162-72, 2006.

Perry, C.E., Buhrman, J.R., "Effect of helmet inertial properties on head and neck response during +Gz impact accelerations," J Gravit Physiol, 2(1):P88-91, 1995.

Rubertone, M.V. and Brundage, J.F., "The Defense Medical Surveillance System and the Department of Defense Serum Repository: glimpses of the future of public health surveillance," Am J Public Health. 92;12:1900-4, 2002.

Smith, S.D., and Smith, J.A., "Head and helmet biodynamics and tracking performance in vibration environments," Aviat Space Environ Med, 77(4):388-97, 2006.

Smith, S.D., "Seat vibration in military propeller aircraft: characterization, exposure assessment, and mitigation," Aviat Space Environ Med, 77(1):32-40, 2006.

Smith, T.C., Corbeil, T.E., Ryan, M.A., Heller, J.M., Gray, G.C., "In-theater hospitalizations of US and allied personnel during the 1991 Gulf War," Am J Epidemiol, 159(11):1064-76, 2004.

Warha, D.L., Webb, T.S., Wells, T.S., "Illness and Injury Risk and Healthcare Utilization, united States Air Force Battlefield Airmen and Security Forces, 2000-2005," Mil Med, 174;(9):892-8, 2009.

Waters, T., Collins, J., Galinsky, T., Caruso, C., "NIOSH research efforts to prevent musculoskeletal disorders in the healthcare industry," Orthop Nurs, 25(6):380-9, 2006.

Wells, T.S., Sato, P.A., Smith, T.C., Wang, L.Z., Reed, R.J., Ryan, M.A., "Military hospitalizations among deployed US service members following anthrax vaccination, 1998-2001," Hum Vaccin, 2(2):54-9, 2006.

Yliniemi, E.M., Pellettiere, J.A., Doczy, E.J., Nuckley, D.J., Perry, C.E., Ching, R.P., “Dynamic tensile failure mechanics of the musculoskeletal neck using a cadaver model,” J Biomech Eng, 131(5):051001, 2009.

APPENDIX A. Federal Privacy Act System of Records Notice

Federal Register /Vol. 72, No. 22 / Friday, February 2, 2007 /Notices **5019**
and Records Administration have approved the retention and disposition schedule).

F061 AFMC B DoD

SYSTEM NAME: Biosciences and Protection Epidemiological Database.

SYSTEM LOCATION:
Headquarters, Air Force Material Command (AFMC), Biosciences and Protection Division, Human Effectiveness Directorate, Air Force Research Laboratory/HEP, 2800 Q Street, Wright-Patterson Air Force Base, OH 45433–7947.

CATEGORIES OF INDIVIDUALS COVERED BY THESYSTEM:
Members of the U.S. Armed Forces and Department of Defense civilian employees who potentially have occupational exposures associated with adverse health outcomes.

CATEGORIES OF RECORDS IN THE SYSTEM:
Name, Social Security Number or service number, Sex, Race, Date of Birth, pay grade, rank, assigned unit identification (UIC), service affiliation (Army, Navy, Marines, Air Force, Coast Guard) and component (Active Duty, Guard, Reserve); occupational information, including personnel type and occupation, date and extent of involvement in military deployments or related operations, occupationally related health issues and exposure information, medical treatment information and information on worker's compensation and Veteran's Affairs disabilities. Self-reported information from service members may include demographic information, health outcomes, health related behaviors, and occupational exposure information. Records of biomechanical and ergonomically evaluations for specific system members or duty locations may be included.

AUTHORITY FOR MAINTENANCE OF THE SYSTEM:
10 U.S.C. 131, Office of the Secretary of Defense; 10 U.S.C. 136, Under Secretary of Defense for Personnel and Readiness; and E.O. 9397 (SSN).

PURPOSE(S):
Information is collected for purposes of aeromedical and occupational health research for Department of Defense military and civilian employee populations.

ROUTINE USES OF RECORDS MAINTAINED IN THE SYSTEM, INCLUDING CATEGORIES OF USERS AND THE PURPOSES OF SUCH USES:
In addition to those disclosures generally permitted under 5 U.S.C. 552(b) of the Privacy Act, these records or information contained therein may specifically be disclosed outside the Department of Defense as a routine use pursuant to 5 U.S.C. 552a(b)(3) as follows:
To Federal Aviation Administration, Department of Veterans Affairs, The National Institutes of Health, National Research Council, Occupational Safety and Health Administration, and collaborating academic institutions for purposes of defining health risks associated with military service and in the development of methods to prevent disease, injury, and disability. The

Department of Defense 'Blanket Routine Uses' published at the beginning of the Air Force's compilation of systems of records notices also apply to this system.

POLICIES AND PRACTICES FOR STORING, RETRIEVING, ACCESSING, RETAINING, AND DISPOSING OF RECORDS IN THE SYSTEM:
STORAGE:
Paper records and on electronic storage media.

RETRIEVABILITY:
By individual's name, Social Security Number or service number.

SAFEGUARDS:
Authorized medical personnel and scientists are properly screened and cleared for need-to-know; computer patient records retrievable from remote terminals are protected from unauthorized access or alteration by a data management system requiring a password for access to an authorized subset of data; database management system permits scientists to examine patient records without revealing the unique patient identifiers; records are stored in locked rooms and cabinets; records maintained in computer storage devices are protected by computer system software in accordance with Federal, Department of Defense, and Air Force policy.

RETENTION AND DISPOSAL:
Paper, microfilm, and electronic files will be destroyed when no longer needed. Paper and microfilm records are destroyed by tearing into pieces, shredding, pulping, macerating or burning.

SYSTEM MANAGER(S) AND ADDRESS:
Chief, Biomechanics Branch, Air Force Research Laboratory, Headquarters Air Force Material Command (AFMC), 2800 Q Street, Wright-Patterson Air Force Base, OH 45433–7947.

NOTIFICATION PROCEDURE:
Individuals seeking to determine whether this system of records contains information about themselves should address written inquiries to the Chief, Biomechanics Branch, Biosciences and Protection Division, Human Effectiveness Directorate, Air Force Research Laboratory, Headquarters Air Force Material Command (AFMC), 2800 Q Street, Wright-Patterson Air Force Base, OH 45433–7947. For written inquiries, individuals should provide their full name, Social Security Number or service number, current address, and telephone number in a notarized document. For personal visits, the hours of operation are 0800–1500. Individuals should provide current and valid photo identification.

RECORD ACCESS PROCEDURES:
Individuals seeking access to records about themselves should address written inquiries to the Chief, Biomechanics Branch, Biosciences and Protection Division, Human Effectiveness Directorate, Air Force Research Laboratory, Headquarters Air Force Material Command (AFMC), 2800 Q Street, Wright-Patterson Air Force Base, OH 45433–7947. For written inquiries, individuals should provide their full name, Social Security Number or service number, current address, and telephone number in a notarized document. For personal visits, the hours of

operation are 0800–1500. Individuals should provide current and valid photo identification.

CONTESTING RECORD PROCEDURES:
The Air Force rules for accessing records, and for contesting contents and appealing initial agency determinations are published in Air Force Instruction 33–332, Privacy Act Program; 32 CFR part 806b; or may be obtained from the system manager.

RECORD SOURCE CATEGORIES:
Information is obtained from the subject of the record, military personnel records, and other medical records.

EXEMPTIONS CLAIMED FOR THE SYSTEM:
None.

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APPENDIX B. Tables for Officer Analyses

Table B1. Active Duty US Air Force Officer Demographics Stratified By Sex, October 2001 – December 2005

Characteristic	Men n = 62,742 No. (%)	Women n = 15,072 No. (%)	*p* value*
Career category			
Professional	10318 (16.5)	2100 (13.9)	<.0001
Operations	29208 (46.6)	2806 (18.6)	
Logistics/support	13471 (21.5)	4068 (27.0)	
Medical	9003 (14.4)	5997 (39.8)	
Other/unknown	742 (1.2)	101 (0.7)	
Race/ethnicity			
White non-Hispanic	51601 (82.2)	10853 (72.0)	<.0001
Black non-Hispanic	3121 (5.0)	1713 (11.4)	
Other/unknown	8020 (12.8)	2506 (16.6)	
Marital status			
Married	49690 (79.2)	8952 (59.4)	<.0001
Not married	13052 (20.8)	6120 (40.6)	
Pay grade			
O1-O3	29938 (47.7)	9581 (63.6)	<.0001
$\geq$ O4	32804 (52.3)	5491 (36.4)	
Birth year			
Before 1965	24236 (38.6)	4560 (30.3)	<.0001
1966-1975	25620 (40.8)	5931 (39.4)	
1976 or later	12886 (20.5)	4581 (30.4)	
Period of first service			
Before 1990	34768 (55.4)	5567 (36.9)	<.0001
1991-1995	12375 (19.7)	3209 (21.3)	
1996-2000	10982 (17.5)	3939 (26.1)	
2001-2005	4617 (7.4)	2357 (15.6)	
Duration of service (years)			
$\leq$ 3	8852 (14.1)	3795 (25.2)	<.0001
4-9	17325 (27.6)	5228 (34.7)	
10-15	13681 (21.8)	2573 (17.1)	
$\geq$ 16	22884 (36.5)	3476 (23.1)	
Deployed†			
No	40076 (63.9)	11503 (76.3)	<.0001
Yes	22666 (36.1)	3569 (23.7)	

*Differences between men and women were tested with the Pearson chi-square.

† Deployed in support of Operation Iraqi Freedom or Operation Enduring Freedom.

Table B2. Injury and Injury-related Musculoskeletal Disorder Hospitalizations, By Sex, US Air Force Officer Specialties, October 2001 – December 2005

	Injuries		Injury-related musculoskeletal disorders	
Occupational specialty[*]	Men HR[†] (95%CI)	Women HR[†] (95%CI)	Men HR[†] (95%CI)	Women HR[†] (95%CI)
Operations	1.26 (0.94, 1.68)	1.04 (0.52, 2.07)	1.22 (0.92, 1.61)	1.14 (0.52, 2.52)
Logistics/support	1.12 (0.81, 1.55)	0.87 (0.46, 1.65)	1.25 (0.92, 1.71)	1.42 (0.72, 2.80)
Medical	1.25 (0.89, 1.75)	0.77 (0.43, 1.38)	**1.40** (1.03, 1.91)	1.46 (0.79, 2.72)
Other/unknown	1.36 (0.54, 3.40)	--[‡]	0.41 (0.10, 1.67)	1.58 (0.20, 12.2)

Abbreviations: Hazard Ratio (HR), Confidence Interval (CI).
[*] The Professional/Acquisitions/Finance category was the reference group.
[†] Adjusted for race/ethnicity, marital status, birth year, and deployment status.
[‡]There were no women hospitalized for an injury in this category.

Table B3. Injury and Injury-related Musculoskeletal Disorder Outpatient Diagnoses, By Sex, US Air Force Officer Specialties, October 2001 – December 2005

	Injuries		Injury-related musculoskeletal disorders	
Occupational specialty[*]	Men HR[†] (95%CI)	Women HR[†] (95%CI)	Men HR[†] (95%CI)	Women HR[†] (95%CI)
Operations	**1.07** (1.04, 1.11)	1.06 (0.97, 1.16)	0.97 (0.93, 1.00)	1.07 (0.99, 1.17
Logistics/support	**1.17** (1.13, 1.22)	**1.17** (1.08, 1.26)	**1.21** (1.17, 1.26)	**1.16** (1.07, 1.25)
Medical	**0.85** (0.81, 0.89)	**0.90** (0.84, 0.98)	**0.89** (0.86, 0.93)	0.96 (0.90, 1.04)
Other/unknown	1.00 (0.87, 1.13)	1.17 (0.85, 1.61)	**1.18** (1.06, 1.32)	0.96 (0.70, 1.31)

Abbreviations: Hazard Ratio (HR), Confidence Interval (CI).
[*] The Professional/Acquisitions/Finance category was the reference category.
[†] Adjusted for race/ethnicity, marital status, birth year, and deployment status.

APPENDIX C. Tables for Enlisted Airmen Analyses

Table C1. Active Duty US Air Force Enlisted Airmen Demographics Stratified By Sex, October 2001 – December 2005

Characteristic	Men n = 284,270 No. (%)	Women n = 72,827 No. (%)	*p* value*
Career category			
Aircrew	8557 (3.0)	1097 (1.5)	<.0001
CC/intel/protection/weather/plans	23923 (8.4)	11179 (15.4)	
Info management/communications	20041 (7.1)	8906 (12.2)	
Battlefield airmen†	2469 (0.9)	0 (0.0)	
Maintenance/fuels	80069 (28.2)	5942 (8.2)	
Electronic systems	14158 (5.0)	1237 (1.7)	
Supply/transportation/munitions	40376 (14.2)	9345 (12.8)	
Civil engineering	24245 (8.5)	1664 (2.3)	
Security forces	28283 (10.0)	5528 (7.6)	
Medical	13971 (4 .9)	13870 (19.1)	
Other/unknown	28178 (9.9)	14059 (19.3)	
Race/ethnicity			
White non-Hispanic	200348 (70.5)	42106 (57.8)	<.0001
Black non-Hispanic	40780 (14.4)	17385 (23.9)	
Other/unknown	43142 (15.2)	13336 (18.3)	
Marital status			
Married	174939 (61.5)	39255 (53.9)	<.0001
Not married	109331 (38.5)	33572 (46.1)	
Pay grade			
E1-E3	48038 (16.9)	14370 (19.7)	<.0001
E4-E6	183377 (64.5)	51469 (70.7)	
≥ E7	52855 (18.6)	6988 (9.6)	
Birth year			
Before 1965	56065 (19.7)	7497 (10.3)	<.0001
1966-1975	71895 (25.3)	15847 (21.8)	
1976 or later	156310 (55.0)	49483 (68.0)	
Period of first service			
Before 1990	90763 (31.9)	13174 (18.1)	<.0001
1991-1995	34519 (12.1)	9124 (12.5)	
1996-2000	78934 (27.8)	26656 (36.6)	
2001-2005	80054 (28.2)	23873 (32.8)	
Duration of service (years)			
≤ 3	85765 (30.2)	26635 (36.6)	<.0001
4-9	82885 (29.2)	26890 (36.9)	
10-15	36107 (12.7)	8271 (11.4)	
≥ 16	79513 (28.0)	11031 (15.2)	
Deployed‡			
No	164616 (57.9)	50173 (68.9)	<.0001
Yes	119654 (42.1)	22654 (31.1)	

Abbreviations: Confidence interval (CI), Command (CC), Intelligence (Intel), Information (Info).

* Differences between men and women were tested with the Pearson chi-square.

† Women are not currently authorized to serve in battlefield airmen career fields.

‡ Deployed in support of Operation Iraqi Freedom or Operation Enduring Freedom.

Table C2. Injury and Injury-Related Musculoskeletal Disorder Hospitalizations, By Sex, US Air Force Enlisted Specialties, October 2001 – December 2005

	Injuries		Injury-related musculoskeletal disorders	
Occupational specialty[*]	Men HR[†] (95%CI)	Women HR[†] (95%CI)	Men HR[†] (95%CI)	Women HR[†] (95%CI)
Aircrew	**1.57** (1.23, 2.00)	0.92 (0.37, 2.32)	1.27 (0.98, 1.64)	0.71 (0.26, 1.95)
Battlefield airmen	**4.16** (3.18, 5.44)	--[‡]	**2.85** (2.00, 4.05)	--[‡]
Maintenance/fuels	**1.49** (1.28, 1.74)	**1.60** (1.08, 2.38)	**1.30** (1.11, 1.54)	1.19 (0.81, 1.75)
Electronic systems	**1.32** (1.07, 1.62)	1.76 (0.93, 3.31)	1.13 (0.90, 1.41)	1.58 (0.89, 2.81)
Command/intel/ protection/ weather/plans	1.11 (0.92, 1.34)	**1.51** (1.06, 2.15)	1.06 (0.87, 1.30)	1.22 (0.88, 1.70)
Supply/trans /munitions	**1.70** (1.44, 2.00)	**1.65** (1.14, 2.38)	**1.46** (1.22, 1.73)	1.24 (0.89, 1.75)
Civil engineering	**1.77** (1.48, 2.11)	**2.22** (1.27, 3.88)	**1.86** (1.54, 2.26)	**2.18** (1.28, 3.73)
Security forces	**1.54** (1.29, 1.83)	**1.91** (1.27, 2.87)	**1.40** (1.15, 1.71)	**2.35** (1.61, 3.43)
Medical	1.12 (0.90, 1.39)	1.23 (0.87, 1.74)	1.23 (0.99, 1.52)	1.03 (0.76, 1.40)
Other/unknown	1.16 (0.96, 1.41)	1.14 (0.80, 1.63)	1.17 (0.97, 1.41)	1.06 (0.78, 1.43)

Abbreviations: Hazard Ratio (HR), Confidence Interval (CI).

[*] Info management/comm. category was the reference group.

[†] Adjusted for race/ethnicity, marital status, birth year, and deployment status.

[‡] Battlefield airmen are men only.

Table C3. Injury and Injury-Related Musculoskeletal Disorder Outpatient Diagnoses, By Sex, US Air Force Enlisted Specialties, October 2001 – December 2005

	Injuries		Injury-related musculoskeletal disorders	
Occupational specialty[*]	Men HR[†] (95%CI)	Women HR[†] (95%CI)	Men HR[†] (95%CI)	Women HR[†] (95%CI)
Aircrew	**1.12** (1.08, 1.16)	1.07 (0.98, 1.17)	**1.05** (1.01, 1.09)	0.97 (0.88, 1.06)
Battlefield airmen	**1.52** (1.43, 1.60)	--[‡]	**1.50** (1.41, 1.60)	--[‡]
Maintenance/fuels	**1.07** (1.05, 1.09)	**1.09** (1.04, 1.14)	0.99 (0.97, 1.01)	1.00 (0.96, 1.05)
Electronic systems	**1.10** (1.07, 1.13)	**1.15** (1.06, 1.24)	**1.09** (1.06, 1.12)	**1.11** (1.02, 1.20)
Command/intel/ protection/ weather/plans	**0.93** (0.91, 0.96)	**0.92** (0.88, 0.95)	**0.93** (0.91, 0.96)	**0.93** (0.89, 0.96)
Supply/trans /munitions	**1.16** (1.14, 1.19)	**1.15** (1.10, 1.20)	**1.11** (1.08, 1.14)	**1.13** (1.08, 1.17)
Civil engineering	**1.48** (1.44, 1.52)	**1.32** (1.23, 1.41)	**1.38** (1.35, 1.42)	**1.30** (1.21, 1.40)
Security forces	**1.08** (1.05, 1.11)	1.04 (0.99, 1.10)	**0.95** (0.93, 0.98)	**0.91** (0.87, 0.96)
Medical	**1.06** (1.03, 1.09)	1.01 (0.97, 1.04)	**1.07** (1.04, 1.11)	1.01 (0.97, 1.05)
Other/unknown	1.00 (0.98, 1.03)	1.00 (0.96, 1.04)	1.00 (0.98 1.03)	1.00 (0.96, 1.03)

Abbreviations: Hazard Ratio (HR), Confidence Interval (CI).

[*] Info management/comm. category was the reference group.

[†] Adjusted for race/ethnicity, marital status, birth year, and deployment status.

[‡] Battlefield airmen are men only.

Table C4. Injury-Related Musculoskeletal Disorders and Injury Hazard Ratios among Enlisted Civil Engineering Career Fields, October 2001 – December 2005

	Injury-related musculoskeletal disorders		Injuries	
Group	Hospitalization HR* (95%CI)	Outpatient HR* (95%CI)	Hospitalization HR* (95%CI)	Outpatient HR* (95%CI)
Electric Power Production	1.14 (0.59, 2.19)	1.07 (0.96, 1.18)	1.59 (0.74, 3.40)	**1.27** (1.15, 1.40)
Electrical Systems	0.80 (0.41, 1.56)	1.00 (0.90, 1.10)	1.78 (0.85, 3.72)	**1.20** (1.09, 1.33)
Pest Management	0.47 (0.11, 2.07)	0.92 (0.77, 1.09)	**2.77** (1.07, 7.23)	1.17 (1.00, 1.37)
Explosive Ord Disposal	1.07 (0.53, 2.17)	**0.88** (0.80, 0.96)	1.78 (0.82, 3.89)	1.02 (0.91, 1.13)
Fire Protection	1.06 (0.58, 1.92)	1.09 (0.99, 1.20)	1.82 (0.90, 3.68)	**1.10** (1.01, 1.21)
HVAC & Refrigeration	1.07 (0.57, 1.99)	0.93 (0.80, 1.08)	1.51 (0.72, 3.17)	**1.24** (1.13, 1.37)
Liquid Fuels Maintenance	1.68 (0.73, 3.87)	0.90 (0.79, 1.01)	0.95 (0.29, 3.08)	1.04 (0.90, 1.21)
Operations Management	0.89 (0.40, 1.98)	**1.22** (1.11, 1.35)	1.56 (0.64, 3.79)	0.96 (0.85, 1.09)
Pavements & Const Equip	1.23 (0.66, 2.29)	1.09 (0.97, 1.23)	1.75 (0.84, 3.64)	**1.43** (1.30, 1.57)
Readiness	0.67 (0.28, 1.59)	**1.15** (1.05, 1.27)	0.88 (0.31, 2.48)	**1.25** (1.12, 1.41)
Structural	0.97 (0.52, 1.83)	**1.19** (1.08, 1.31)	1.34 (0.63, 2.84)	**1.43** (1.30, 1.57)
Utilities Systems	1.39 (0.75, 2.56)	**1.24** (1.15, 1.33)	1.72 (0.81, 3.66)	**1.33** (1.21, 1.47)

Abbreviations: Hazard Ratio (HR), Confidence Interval (CI), Ordinance (Ord), Heating, Ventillation, and Air Conditioning (HVAC), Construction Equipment (Const Equip).
*Hazard ratios adjusted for race/ethnicity, marital status, birth year, and deployment status, using engineering as the reference group.

Table C5. Combined Inpatient and Outpatient Injury-Related Musculoskeletal Disorder and Barrel Matrices, October 2001 – December 2005

Outcome	Overall Percentage*	Percentile* range
1. Injury-related Musculoskeletal Disorders		
Overuse of Back	26.9	25.1 – 28.4
Overuse of Knee, lower leg	18.9	16.5 – 20.4
Overuse of Ankle, foot	12.5	10.8 – 14.3
Overuse of Shoulder	11.6	10.8 – 13.4
Overuse of C-Spine	3.8	3.5 – 4.6
2. Injuries		
Hand, wrist, fingers	19.0	18.1 – 21.0
Lower leg, ankle	12.2	10.9 – 13.9
Lower leg, unspecified	10.1	9.2 – 11.3
Back	8.8	7.9 – 9.3
Shoulder, upper arm	7.4	6.9 – 8.3

*****Percent of total injury-related musculoskeletal disorders or injuries

Table C6. Injury-Related Musculoskeletal Disorders and Injury Hazard Ratios among Enlisted Civil Engineering Career Fields, By Major Command, October 2001 – December 2005

	Injury-related musculoskeletal disorders		Injuries	
Command	Hospitalization HR* (95%CI)	Outpatient HR* (95%CI)	Hospitalization HR* (95%CI)	Outpatient HR* (95%CI)
Air Combat	1.08 (0.70, 1.67)	0.99 (0.93, 1.05)	1.02 (0.69, 1.51)	**0.89** (0.85, 0.94)
AF Materiel	1.21 (0.71, 2.07)	0.97 (0.90, 1.05)	1.06 (0.64, 1.75)	0.93 (0.87, 1.00)
AF Special Operations	1.74 (0.95, 3.19)	**1.17** (1.05, 1.29)	1.01 (0.53, 1.90)	1.01 (0.92, 1.10)
AF Space Command	1.08 (0.62, 1.89)	1.02 (0.94, 1.10)	**0.37** (0.18, 0.76)	**0.83** (0.77, 0.90)
Air Mobility	1.34 (0.85, 2.13)	0.99 (0.92, 1.06)	1.20 (0.78, 1.83)	**0.91** (0.86, 0.97)
Pacific Air Force	1.52 (0.97, 2.38)	**0.93** (0.87, 0.99)	1.33 (0.88, 2.00)	**0.86** (0.81, 0.91)
USAF Europe	1.53 (0.95, 2.49)	**0.87** (0.80, 0.94)	1.52 (0.99, 2.33)	**0.80** (0.74, 0.85)

Abbreviations: Hazard Ratio (HR), Confidence Interval (CI).

*Hazard ratios adjusted for race/ethnicity, marital status, birth year, and deployment status, using Air Education and Training Command as the reference group.

APPENDIX D. Tables for Disability Analyses

Table D1. Active Duty US Air Force Officer Demographics, Disability Analysis, October 2001 – December 2005

	Men n = 13455		Women n = 3834	
Characteristic*	Non-disabled	Disabled	Non-disabled	Disabled
Career category				
Professional	1471 (18.3)	905 (16.8)	288 (12.3)	185 (12.3)
Operations	3156 (39.1)	2200 (40.9)	434 (18.6)	222 (14.8)
Logistics/support	1495 (18.5)	1168 (21.7)	615 (26.4)	337 (22.5)
Medical	1799 (22.3)	958 (17.8)	985 (42.2)	736 (49.1)
Other/unknown	147 (1.8)	153 (2.8)	12 (0.05)	20 (1.3)
Race/ethnicity				
White non-Hispanic	5697 (70.6)	3757 (69.8)	1531 (65.5)	952 (63.5)
Black non-Hispanic	292 (3.6)	252 (4.7)	176 (7.5)	161 (10.7)
Other/unknown	2082 (25.8)	1375 (25.5)	627 (26.9)	387 (25.8)
Marital status				
Married	6326 (78.4)	4759 (88.4)	1531 (65.6)	984 (65.5)
Not married	1745 (21.6)	625 (11.6)	803 (34.4)	516 (34.4)
Pay grade				
O1-O3	3389 (42.0)	832 (15.5)	1625 (69.6)	584 (38.9)
$\geq$ O4	4682 (58.0)	4552 (84.6)	709 (30.4)	916 (61.1)
Birth year				
Before 1965	3910 (48.5)	4590 (85.3)	570 (24.4)	945 (63.0)
1966-1975	3260 (40.4)	653 (12.1)	1158 (49.6)	402 (26.8)
1976 or later	901 (11.2)	141 (2.6)	606 (26.0)	153 (10.2)
Period of first service				
Before 1990	4907 (60.8)	4752 (88.3)	670 (28.7)	913 (60.9)
1991-1995	1813 (22.5)	392 (7.3)	753 (31.8)	262 (17.5)
1996-2000	1174 (14.6)	208 (3.9)	743 (31.8)	268 (17.9)
2001-2005	177 (2.2)	32 (0.6)	168 (7.2)	57 (3.8)
Duration of service (years)				
$\leq$ 3	822 (10.2)	129 (2.4)	464 (19.9)	133 (8.9)
4-9	2730 (33.8)	545 (10.1)	1262 (54.1)	454 (30.3)
10-15	1248 (15.5)	268 (5.0)	256 (11.0)	128 (8.5)
$\geq$ 16	3271 (40.5)	4442 (82.5)	352 (15.1)	785 (52.3)
Deployed†				
No	6091 (75.5)	4279 (79.5)	1909 (81.8)	1299 (86.6)
Yes	1980 (24.5)	1105 (20.5)	425 (18.2)	201 (13.4)

* Differences were tested with the Pearson chi-square test of association, with all being statistically significant ($p<0.05$) except marital status for women.

† Deployed in support of Operation Iraqi Freedom or Operation Enduring Freedom.

Table D2. Active Duty US Air Force Enlisted Airmen Demographics, Disability Analysis, October 2001 – December 2005

	Men n = 81306		Women n = 22452	
Characteristic*	Non-disabled	Disabled	Non-disabled	Disabled
Career category				
Aircrew	1158 (2.2)	901 (3.2)	190 (1.3)	84 (1.1)
CC/intel/protection/weather/plans	4635 (8.8)	2770 (9.7)	2513 (17.3)	1053 (13.3)
Info management/communications	4103 (7.8)	2513 (8.8)	1741 (12.0)	1157 (14.6)
Battlefield airmen†	376 (0.7)	264 (0.9)	--	--
Maintenance/fuels	15193 (28.9)	7018 (24.5)	1241 (8.6)	576 (7.3)
Electronic systems	2691 (5.1)	1675 (5.9)	245 (1.7)	117 (1.5)
Supply/transportation/munitions	6817 (12.9)	3766 (13.2)	1763 (12.2)	1045 (13.2)
Civil engineering	5494 (10.4)	2399 (8.4)	362 (2.5)	181 (2.3)
Security forces	6218 (11.8)	2026 (7.1)	1377 (9.5)	450 (5.7)
Medical	2139 (4.1)	1817 (6.4)	2542 (17.5)	1561 (19.7)
Other/unknown	3846 (7.3)	3487 (12.2)	2535 (17.5)	1719 (21.6)
Race/ethnicity				
White non-Hispanic	33878 (64.3)	16905 (59.0)	7988 (55.1)	4174 (52.6)
Black non-Hispanic	6518 (12.4)	4017 (14.0)	2534 (17.5)	1701 (21.4)
Other/unknown	12274 (23.3)	7714 (26.9)	3987 (27.5)	2068 (26.0)
Marital status				
Married	24711 (46.9)	22032 (76.9)	7623 (52.5)	4640 (58.4)
Not married	27959 (53.1)	6604 (23.1)	6886 (47.5)	3303 (41.6)
Pay grade				
E1-E3	13884 (26.4)	1597 (5.6)	4129 (28.5)	870 (11.0)
E4-E6	31131 (59.1)	12456 (43.5)	9632 (66.4)	5029 (63.3)
$\geq$ E7	7655 (14.5)	14583 (50.9)	748 (5.2)	2044 (25.7)
Birth year				
Before 1965	10788 (20.5)	19037 (66.5)	1034 (7.1)	2772 (34.9)
1966-1975	6691 (12.7)	3672 (12.8)	1989 (13.7)	1559 (19.6)
1976 or later	35191 (66.8)	5927 (20.7)	11486 (79.2)	3612 (45.5)
Period of first service				
Before 1990	12375 (23.5)	20728 (72.4)	1291 (8.9)	3169 (39.9)
1991-1995	4346 (8.3)	1674 (5.9)	1389 (9.6)	989 (12.5)
1996-2000	23193 (44.0)	4654 (16.3)	7774 (53.6)	2883 (36.3)
2001-2005	12756 (24.2)	1580 (5.5)	4055 (28.0)	902 (11.4)
Duration of service (years)				
$\leq$ 3	22338 (42.4)	3017 (10.5)	7303 (50.3)	1865 (23.5)
4-9	16799 (31.9)	4319 (15.1)	5546 (38.2)	2596 (32.7)
10-15	1916 (3.6)	942 (3.3)	550 (3.8)	509 (6.4)
$\geq$ 16	11617 (22.1)	20358 (71.1)	1110 (7.6)	2973 (37.4)
Deployed‡				
No	35125 (66.7)	21086 (73.6)	11077 (76.4)	6292 (79.2)
Yes	17545 (33.3)	7550 (26.4)	3432 (23.7)	1651 (20.8)

Abbreviations: Command (CC), Intelligence (Intel), Information (Info).

* Differences were tested with the Pearson chi-square test of association, with all differences being statistically significant ($p<0.05$).

† Battlefield airmen career fields are restricted to men only.

‡Deployed in support of Operation Iraqi Freedom or Operation Enduring Freedom.

Table D3. Adjusted Hazard for Officer and Enlisted, Male and Female Airmen Receiving VA Disability Compensation, October 2001 – December 2005

	Men	Women
Air Force Specialty	HR* (95%CI)	HR* (95%CI)
Officers		
Operations	1.08 (0.97, 1.20)	0.98 (0.75, 1.28)
Logistics/support	**1.45** (1.28, 1.64)	0.90 (0.70, 1.15)
Medical	0.94 (0.84, 1.07)	0.94 (0.75, 1.19)
Other/unknown	1.03 (0.80, 1.32)	1.55 (0.71, 3.43)
Enlisted		
Aircrew	1.11 (0.99, 1.24)	0.83 (0.62, 1.10)
CC/intel/protection/weather/plans	1.04 (0.97, 1.13)	**0.84** (0.75, 0.95)
Battlefield airmen†	**1.44** (1.19, 1.73)	--
Maintenance/fuels	**1.12** (1.05, 1.20)	0.92 (0.80, 1.05)
Electronic systems	1.04 (0.96, 1.14)	**0.71** (0.55, 0.91)
Supply/transportation/munitions	**1.19** (1.11, 1.28)	1.07 (0.95, 1.20)
Civil engineering	**1.19** (1.10, 1.29)	1.09 (0.89, 1.34)
Security forces	0.98 (0.91, 1.07)	0.88 (0.76, 1.01)
Medical	**1.42** (1.30, 1.56)	**1.14** (1.02, 1.27)
Other/unknown	**1.12** (1.04, 1.21)	0.94 (0.85, 1.05)

Abbreviations: Command (CC), Intelligence (Intel), Information (Info).

*Adjusted for race/ethnicity, marital status, birth year, and deployment status, and those officers serving in professional career fields and those enlisted Airmen serving in info management/communications served as the respective reference categories.

APPENDIX E. Tables for Analyses of Direct Medical Costs

Table E1. Direct Medical Costs Associated With Injury-Related Musculoskeletal Disorders and Injuries, October 2001 - December 2005

	Injury-related musculoskeletal disorders		Injuries	
Group	Total cost ($)	Cost per person-year	Total cost ($)	Cost per person-year
Officers				
Logistics/Support	2,004,422	38.5	2,902,527	55.8
Medical	3,308,485	67.9	1,622,467	33.3
Operations	3,982,475	40.2	4,337,363	43.8
Professional	1,359,849	38.3	2,475,173	69.7
Other	12,675	6.7	15,636	8.3
Enlisted				
Aircrew	1,933,022	66.3	3,807,957	130.6
Battlefield Airmen	560,551	79.4	1,071,909	151.9
Command/Intel	5,742,562	55.5	5,905,780	57.1
Civil Engineering	6,570,448	84.1	6,496,688	83.2
Electronic Systems	2,537,641	53.3	3,669,696	77.0
Info Mngmnt/Comm	4,588,365	49.8	4,043,855	43.9
Maintenance/Fuels	18,862,131	70.6	33,727,155	126.3
Medical	4,932,678	57.8	4,169,733	48.9
Security Forces	5,102088	53.1	8,066,822	83.9
Supply/Trans/Munitions	9,214,846	59.1	14,283,983	91.6
Other	7,797,006	68.2	5,881,165	51.5
Total	78,509,244		94,411,087	

Table E2. Direct Medical Costs for Injury-Related Musculoskeletal Disorders and Injuries, by Civil Engineering Specialty, October 2001 – December 2005

Civil Engineering Specialty	Injury-related musculoskeletal disorders		Injuries	
	Total cost ($)	Cost per person-year	Total cost ($)	Cost per person-year
Electric Power Production	540,372	80.1	777,409	115.2
Electrical Systems	483,755	60.8	940,721	118.3
Engineering	130,259	35.1	31,695	8.5
Pest Management	8,374	7.4	162,962	144.4
Explosive Ord Disposal	257,420	53.6	366,492	76.3
Fire Protection	814,170	52.0	1,119,874	71.5
HVAC & Refrigeration	579,085	66.9	1,051,664	121.6
Liquid Fuels Maintenance	108,036	75.9	53,232	37.4
Operations Management	453,997	167.1	222,589	81.9
Pavements & Const Equip	969,232	108.6	617,276	69.1
Readiness	277,874	96.9	48,571	16.9
Structural	1,089,683	130.1	541,044	64.6
Utilities Systems	1,075,167	152.0	469,825	66.4
Total	6,787,425		6,404,354	

Abbreviations: Ordinance (Ord), Heating, Ventillation, and Air Conditioning (HVAC), Construction Equipment (Const Equip).

APPENDIX F. Job Requirements and Physical Demands Survey

JOB REQUIREMENTS AND PHYSICAL DEMANDS SURVEY

Job Requirements and Physical Demands Survey	Date (YYMMDD)	**Workplace Identifier:**	
(use this space for mechanical imprint)		Base	Organization
		Workplace	
		Bldg. No/Location	Room/Area
		AFSC/Job Series	
Gender:	Female ❍	Male ❍	
Work Group:	Civilian ❍ Grade:_____	Military ❍ Rank:_____	
Age Category:	20 and under ❍	21-30 ❍	31-40 ❍ over 40 ❍
Length of service at this base:	less than one year ❍	more than one year ❍	
Length of time in current shop:	less than one year ❍	more than one year ❍	
Have you completed this questionnaire before?	Yes ❍	No ❍	

Part I – Job Factors

This section enables you to describe what is involved in your job. Indicate how long you do this work on approximately a daily basis.

A. DESCRIPTION OF WORK

SHOULDER / NECK

	Never	0-2 hrs.	2-4 hrs.	4-8 hrs.
1. I work with my hands at or above chest level. *(Figure A.)*	❍	❍	❍	❍

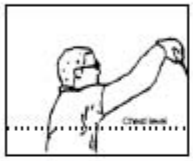


Figure A.

2. To get to or to do my work, I must lay on my back or side and work with my arms up.	❍	❍	❍	❍
3. I must hold or carry materials (or large stacks of files) during the course of my work.	❍	❍	❍	❍
4. I force or yank components or work objects in order to complete a task.	❍	❍	❍	❍
5. I reach or hold my arms in front of or behind my body (e.g., using a keyboard, filing, handling parts, performing inspection tasks, pushing or pulling carts, etc.). *(Figures B.)*	❍	❍	❍	❍

Figure B.

6. My neck is tipped forward or backward when I work. (*Figure C.)*	❍	❍	❍	❍

Figure C.

7. I cradle a phone or other device between my neck and shoulder. *(Figure D.)*	❍	❍	❍	❍

Figure D.

Part I – Job Factors (continued)

Figure E.

Figure F.

	Never	0-2 hrs.	2-4 hrs.	4-8 hrs.
8. My wrists are bent (up, down, to the thumb or little finger side) while I work. *(Figure E.)*	❍	❍	❍	❍
9. I apply pressure or hold an item/material/tool (e.g., screw driver, spray gun, mouse, etc.) in my hand for longer than 10 seconds at a time.	❍	❍	❍	❍
10. My work requires me to use my hands in a way that is similar to wringing out clothes. *(Figure F.)*	❍	❍	❍	❍
11. I perform a series of repetitive tasks or movements during the normal course of my work (e.g., using a keyboard, tightening fasteners, cutting meat, etc.).	❍	❍	❍	❍
12. The work surface (e.g., desk, bench, etc.) or tool(s) that I use presses into my palm(s), wrist(s), or against the sides of my fingers leaving red marks on or beneath the skin.	❍	❍	❍	❍
13. I use my hand/palm like a hammer to do certain aspects of my work.	❍	❍	❍	❍
14. My hands and fingers are cold when I work.	❍	❍	❍	❍
15. I work at a fast pace to keep up with a machine production quota or performance incentive.	❍	❍	❍	❍
16. The tool(s) that I use vibrates and/or jerks my hand(s) and arms(s).	❍	❍	❍	❍
17. My work requires that I repeatedly throw or toss items.	❍	❍	❍	❍
18. My work requires me to twist my forearms, such as turning a screwdriver.	❍	❍	❍	❍
19. I wear gloves that are bulky, or reduce my ability to grip.	❍	❍	❍	❍
20. I squeeze or pinch work objects with a force similar to that which is required to open a lid on a new jar.	❍	❍	❍	❍
21. I grip work objects or tools as if I am gripping tightly onto a pencil.	❍	❍	❍	❍

Part I – Job Factors (continued)

BACK/TORSO

Figure G.

Figure H.

Figure I.

	Never	0-2 hrs.	2-4 hrs.	4-8 hrs.
22. When I lift, move components, or do other aspects of my work, my hands are lower than my knees. *(Figure G.)*	❍	❍	❍	❍
23. I lean forward continually when I work (e.g., when sitting, when standing, when pushing carts, etc.).	❍	❍	❍	❍
24. The personal protective equipment or clothing that I wear limits or restricts my movement.	❍	❍	❍	❍
25. I repeatedly bend my back (e.g., forward, backward, to the side, or twist) in the course of my work.	❍	❍	❍	❍
26. When I lift, my body is twisted and/or I lift quickly. *(Figure H.)*	❍	❍	❍	❍
27. I can feel vibration through the surface that I stand on or through my seat.	❍	❍	❍	❍
28. I lift and/or carry items with one hand. *(Figure I.)*	❍	❍	❍	❍
29. I lift or handle bulky items.	❍	❍	❍	❍
30. I lift materials that weigh more than 25 pounds.	❍	❍	❍	❍

Part I – Job Factors (continued)

Figure J.

Figure K

LEGS / FEET

	Never	0-2 hrs.	2-4 hrs.	4-8 hrs.
31. My work requires that I kneel or squat. *(Figure J.)*	❍	❍	❍	❍
32. I must constantly move or apply pressure with one or both feet (e.g., using foot pedals, driving, etc.).	❍	❍	❍	❍
33. When I'm sitting, I cannot rest both feet flat on the floor. *(Figure K.)*	❍	❍	❍	❍
34. I stand on hard surfaces.	❍	❍	❍	❍

HEAD / EYES

35. I can see glare on my computer screen or work surface.	❍	❍	❍	❍
36. It is difficult to hear a person on the phone or to concentrate because of other activity, voices, or noise in/near my work area.	❍	❍	❍	❍
37. I must look at the monitor screen constantly so that I do not miss important information (radar scope).	❍	❍	❍	❍
38. It is difficult to see what I am working with (monitor, paper, parts, etc.).	❍	❍	❍	❍

Part I – Job Factors (continued)

B. ORGANIZATIONAL FACTORS

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
	1	2	3	4	5
39. I often feel unclear on what the scope and responsibilities of my job are.	❍	❍	❍	❍	❍
40. I often feel that I have too heavy of a workload, one that I could not possibly finish during an ordinary workday.	❍	❍	❍	❍	❍
41. I often feel that I will not be able to satisfy the conflicting demands of various people around me.	❍	❍	❍	❍	❍
42. I often find myself unable to get information needed to carry out my job.	❍	❍	❍	❍	❍
43. I often do not know what my supervisor thinks of me, how he/she evaluates my performance.	❍	❍	❍	❍	❍
44. I often think that the amount of work I have to do interferes with how well it's done.	❍	❍	❍	❍	❍

C. PHYSICAL EFFORT

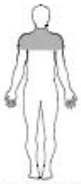
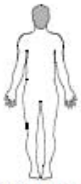
45. How would you describe the physical effort required of your job?

6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
No exertion at all	Extremely light		Very light		Light		Somewhat hard		Hard		Very hard		Extremely hard	Maximal exertion
❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

Part II – Your Body's Response to Work Demands

D. DISCOMFORT FACTORS

This section enables you to identify how your body responds to the demands of *your job*. In each section, answer the first question. If the answer is "no" go to the next column.

Question	 Shoulder/Neck	 Hands/Wrists/Arms	 Back/Torso	 Legs/Feet	 Head/Eyes
• In the past 12 months, have you experienced any discomfort, fatigue, numbness, or pain that *relates to your job*?	46. Yes ❍ No ❍ ***If "no", go to question 49***	49. Yes ❍ No ❍ ***If "no", go to question 52***	52. Yes ❍ No ❍ ***If "no", go to question 55***	55. Yes ❍ No ❍ ***If "no", go to question 58***	58. Yes ❍ No ❍ ***If "no", go to question 61***
• How often do you experience discomfort, fatigue, numbness, or pain in this region of the body?	47. Daily ❍ Weekly ❍ Monthly ❍	50. Daily ❍ Weekly ❍ Monthly ❍	53. Daily ❍ Weekly ❍ Monthly ❍	56. Daily ❍ Weekly ❍ Monthly ❍	59. Daily ❍ Weekly ❍ Monthly ❍
• On average, how severe is the discomfort, fatigue, numbness, or pain in this region of the body?	48. Mild ❍ Moderate ❍ Severe ❍	51. Mild ❍ Moderate ❍ Severe ❍	54. Mild ❍ Moderate ❍ Severe ❍	57. Mild ❍ Moderate ❍ Severe ❍	60. Mild ❍ Moderate ❍ Severe ❍

Part II – Your Body's Response to Work Demands (continued)

E. GENERAL QUESTIONS

61. In the past 12 months, have you seen a health care provider for any pain or discomfort that you think **relates to your job**? Yes ❍ No ❍

62. Do you experience any work-related pain or discomfort that does not improve when you are away from work overnight or over the weekend? Yes ❍ No ❍

63. In the past 12 months, has any work-related pain or discomfort caused you difficulty in carrying out normal activities (e.g., job, hobby, leisure, etc.)? Yes ❍ No ❍

64. Has a health care provider ever told you that you have any of the following conditions which you think might be **related to your work**? Yes ❍ No ❍

- Tendonitis/Tenosynovitis
- Epicondylitis (Tennis Elbow)
- Thoracic Outlet Syndrome
- Ganglion Cyst
- Bursitis
- Back Strain
- Trigger Finger
- Carpal Tunnel Syndrome
- Knee or Ankle Strain
- Overuse Syndrome

65. Do you have or have you ever had one or more of the following conditions? Yes ❍ No ❍

- Wrist Fracture
- Thyroid Disorder
- Rheumatoid Arthritis
- Hypertension
- Diabetes
- Kidney Disorders
- Gout

Part III - Work Content

The section below will enable you to describe the content of the work that you do in your current shop.

Fill in the box that describes how frequently you do the task listed, based on the following definitions:

- **Routine:** Performed on three or more days per week.
- **Non-routine:** Performed two days a week or less.
- **Seasonal:** Performed only during certain times of the year
- **Never/NA:** You do not perform this type of work.

No.	Type of Work	Work Frequency (Check one)			
		Routine	Non-Routine	Seasonal	Never/NA
66.	abrading	❍	❍	❍	❍
67.	baking	❍	❍	❍	❍
68.	bolting/screwing	❍	❍	❍	❍
69.	calling (telephone use)	❍	❍	❍	❍
70.	chipping	❍	❍	❍	❍
71.	cleaning by hand	❍	❍	❍	❍
72.	cleaning with high pressure equipment	❍	❍	❍	❍
73.	coating/immersing	❍	❍	❍	❍
74.	cooking	❍	❍	❍	❍
75.	copying	❍	❍	❍	❍
76.	crimping	❍	❍	❍	❍
77.	cutting/shearing	❍	❍	❍	❍
78.	drafting/CAD system use	❍	❍	❍	❍
79.	drilling	❍	❍	❍	❍
80.	driving (vehicles)	❍	❍	❍	❍
81.	excavating	❍	❍	❍	❍
82.	filing/general administrative	❍	❍	❍	❍
83.	flame cutting/arc cutting	❍	❍	❍	❍
84.	folding/fitting	❍	❍	❍	❍
85.	gluing/laminating	❍	❍	❍	❍
86.	grinding/buffing/polishing	❍	❍	❍	❍
87.	hammering	❍	❍	❍	❍
88.	lifting	❍	❍	❍	❍
89.	loading (pallets, trucks, carts, aircraft)	❍	❍	❍	❍
90.	lubricating	❍	❍	❍	❍

Part III – Work Content (Continued)

No.	Type of Work	Work Frequency (Check one)			
		Routine	Non-Routine	Seasonal	Never/NA
91.	machining	❍	❍	❍	❍
92.	masoning	❍	❍	❍	❍
93.	melting	❍	❍	❍	❍
94.	molding	❍	❍	❍	❍
95.	monitoring (visual displays)	❍	❍	❍	❍
96.	mousing (for computer work)	❍	❍	❍	❍
97.	nailing	❍	❍	❍	❍
98.	opening/closing heavy doors	❍	❍	❍	❍
99.	packing/packaging	❍	❍	❍	❍
100.	painting/spray painting	❍	❍	❍	❍
101.	paving	❍	❍	❍	❍
102.	pumping (by hand)	❍	❍	❍	❍
103.	riveting/bucking	❍	❍	❍	❍
104.	sanding	❍	❍	❍	❍
105.	sawing	❍	❍	❍	❍
106.	scanning (using bar code readers)	❍	❍	❍	❍
107.	sewing	❍	❍	❍	❍
108.	soldering/brazing	❍	❍	❍	❍
109.	stapling	❍	❍	❍	❍
110.	stripping/depainting by hand	❍	❍	❍	❍
111.	stripping/depainting mechanically	❍	❍	❍	❍
112.	transporting loads on non-powered carts	❍	❍	❍	❍
113.	turning valves	❍	❍	❍	❍
114.	tying/twisting/wrapping	❍	❍	❍	❍
115.	typing/keying	❍	❍	❍	❍
116.	welding	❍	❍	❍	❍
117.	wheeling loads	❍	❍	❍	❍
118.	wiring	❍	❍	❍	❍
119.	wrenching/ratcheting	❍	❍	❍	❍
120.	writing/illustrating	❍	❍	❍	❍
	(Write in others)				
121.	_____	❍	❍	❍	❍
122.	_____	❍	❍	❍	❍

Part IV – Process Improvement Opportunities

Think about your job as a whole, including routine, non-routine or seasonal work.

Read the questions listed below and **describe the activities** that you or your co-workers think place the greatest demands on your body.

1. Which tasks are the most awkward or require you to work in the most uncomfortable positions?

2. Which tasks take the most effort?

3. Are there any tools or pieces of equipment that are notoriously hard to work with? (If so, list them below)

4. If you could make any suggestions that would help you do your job more easily or faster or better, what would you suggest?

SYMBOLS

And (&)
Percent (%)
Dollar ($)
Equals (=)

ABBREVIATIONS & ACRONYMS

U.S. Air Force (USAF)
Job Requirements Physical Demands Survey (JRPDS)
Vulnerability Analysis Branch (711th HPW/RHPA)
U.S. Bureau of Labor Statistics (BLS)
Department of Defense (DoD)
(International Classification of Diseases, 9th Revision, Clinical Modifications (ICD-9-CM)
not elsewhere classifiable (nec)
Vulnerability Analysis Branch (711th HPW/RHPA)
Veteran's Adminstration (VA)
Defense Manpower Data Center (DMDC)
Military Health System (MHS)
Air Force Specialty Codes (AFSCs)
Standard Inpatient Data Record (SIDR)
Standard Ambulatory Data Record (SADR)
US Army Center for Health Promotion and Preventive Medicine (USACHPPM)
Heating, Ventilation and Air Conditioning (HVAC)
USAF School of Aerospace Medicine (USAFSAM)
major command (Majcom)
Air Education and Training Command (AETC)
Operation Iraqi Freedom (OIF)
Operation Enduring Freedom (OEF)
Pacific Air Force (PACAF)
U.S. Air Forces, Europe (USAFE)
Job Requirements Physical Demands Survey (JRPDS)